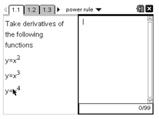
3.3a Rules for Differentiation

Use Power Rule.tns to discover the power rule for derivatives



$y = x^a$

$y' = \frac{dy}{dx} = ax^{a-1}$

$y = x^n$

$y' = nx^{n-1}$

$\frac{d}{dx}\left(\frac{1}{x}\right) = \frac{d}{dx}(x^{-1}) = -1x^{-2} = \frac{-1}{x^2}$

pencil calc

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$y = bx^a$

$y' = abx^{a-1}$

$\frac{d}{dx}(7x^3) = 21x^2$

$\frac{d}{dx}(14x) = 14$

$\frac{d}{dx}(7) = 0$

$7x^0$

$\frac{d}{dx}(c) = 0$

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Proof of the power rule

$\frac{d}{dx}x^n = \lim_{h\to 0}\frac{f(x+h)-f(x)}{h} = \lim_{h\to 0}\frac{(x+h)^n - x^n}{h}$

$\lim_{h\to 0}\frac{[\cancel{x^n} + nx^{n-1}h + \frac{n(n-1)}{2}x^{n-2}h^2 + \dots + h^n] - \cancel{x^n}}{h}$

$\lim_{h\to 0}\frac{\cancel{h}[nx^{n-1} + \frac{(n-1)(n-2)}{2}x^{n-2}h + \dots + h^{n-1}]}{\cancel{h}} = nx^{n-1}$

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Find $\frac{dy}{dx}$ if $y = x^3 + 6x^2 - \frac{5}{3}x + 16$

$y' = 3x^2 + 12x - \frac{5}{3}$

$\frac{d}{dx}[f(x) \pm g(x)] = f'(x) \pm g'(x)$

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Find the horizontal tangents of $y = x^4 - 2x^2 + 2$

graph

by hand

$y' = 4x^3 - 4x = 0$

$4x(x^2-1) = 0$

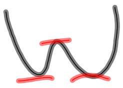
$4x(x+1)(x-1) = 0$

$x = 0, 1, -1$

$y = 2$

$y = 1$

with the calculator



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higher order derivatives

$y = x^4$

$y' = 4x^3$

$y'' = 12x^2$

$y''' = 24x$

$y^4 = 24$

$y^5 = 0$

$y^6 = 0$

$\vdots$

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